PERFORMANCE AUDIT
OF THE

DESIGN DIVISION

BUREAU OF HIGHWAY TECHNICAL SERVICES
MICHIGAN DEPARTMENT OF TRANSPORTATION

July 2002

EXECUTIVE DIGEST

DESIGN DIVISION

INTRODUCTION

This report, issued in July 2002, contains the results of our performance audit* of the Design Division, Bureau of Highway Technical Services, Michigan Department of Transportation (MDOT).

AUDIT PURPOSE

This performance audit was conducted as part of the constitutional responsibility of the Office of the Auditor General. Performance audits are conducted on a priority basis related to the potential for improving effectiveness* and efficiency*.

BACKGROUND

MDOT was organized under Sections 16.450 - 16.458 of the *Michigan Compiled Laws* (Executive Organization Act of 1965). MDOT was established to provide the people of Michigan with a safe, efficient, and environmentally sound total transportation system in the most cost-effective manner.

The Design Division is 1 of 5 divisions within the Bureau of Highway Technical Services that provides construction plans and design services to MDOT staff in Lansing and at the 7 regional offices and 26 transportation service centers. The Division's mission is to:

> Provide and support the development of quality transportation project documents and services that meet the Department's strategic goals and

** See glossary at end of report for definition.*

exceed customer expectations for delivery of contracts on time and within budget.

The Division is organized into two units (Administrative Support and Local Agency Programs) and three sections (Design Operations - Road Section, Design Operations - Structures Section, and Design Services Section).

Administrative Support provides office management functions and liaison services with MDOT for the Division. Local Agency Programs administers the federal and State aid programs for local agencies.

The Design Operations - Road Section and the Design Operations - Structures Section are responsible for preparing preliminary and final design plans for construction or reconstruction of State trunkline roads and bridges; distributing design work loads among Lansing design, region design, and design projects awarded to design consultants*; and coordinating region design squads in the preparation of preliminary and final plans for State trunkline roads and bridges.

The Design Services Section is responsible for coordinating and implementing automated engineering systems and standards for the Division, coordinating value engineering studies, and the review and approval of subdivision plats impacting State trunklines.

Division expenditures, including design consultant contracts, were approximately $68.1 million for the fiscal year ended September 30, 2001. The Division had 280 full-time equated employees as of September 30, 2001.

AUDIT OBJECTIVES AND CONCLUSIONS

Audit Objective: To assess the effectiveness of MDOT's life cycle cost analysis (LCCA) program.

** See glossary at end of report for definition.*

Conclusion: We concluded that MDOT's LCCA program was effective in ensuring that the lowest life cycle construction cost alternative was selected for construction projects with paving costs greater than $1 million.

Audit Objective: To assess the effectiveness of the Division's quality assurance (QA) program.

Conclusion: We concluded that the Division's QA program was generally effective in helping to ensure that all road and structure plans were free of errors and omissions. However, we noted reportable conditions* regarding QA reviews and design error notification (Findings 1 and 2).

Audit Objective: To evaluate MDOT management's use of its program/project management system (P/PMS) for scheduling and managing design resources.

Conclusion: We concluded that MDOT management generally made effective use of its P/PMS for scheduling and managing design resources. However, we noted a reportable condition regarding P/PMS data accuracy (Finding 3).

AUDIT SCOPE AND METHODOLOGY

Our audit scope was to examine the program and other records of the Design Division. Our audit was conducted in accordance with *Government Auditing Standards* issued by the Comptroller General of the United States and, accordingly, included such tests of the records and such other auditing procedures as we considered necessary in the circumstances.

** See glossary at end of report for definition.*

Our audit procedures included examination of the Division's records and activities primarily for the period October 1, 1998 through June 30, 2001. Our audit methodology included conducting a preliminary survey of the Division to develop an understanding of its responsibilities and the methods that it used to monitor the accomplishment of these responsibilities. We reviewed prior audit reports and working papers of audits conducted by MDOT's Office of Commission Audits. We obtained Division design manuals for use as reference materials during our audit.

We reviewed the Division's procedures for preparing, reviewing, and submitting project design plans for bid lettings*. This included the procedures for managing project designs prepared by private firms.

We received listings of construction projects that the Division released for bid lettings during our audit period. From those listings, we performed various tests to determine compliance with Division procedures.

We reviewed the Division's policies and procedures for maintaining and using its P/PMS. We obtained reports from P/PMS and performed various analytical tests.

AGENCY RESPONSES

Our audit report contains 3 findings and 4 corresponding recommendations. The agency preliminary responses indicated that MDOT concurs with all 4 recommendations. In addition, MDOT informed us that it has initiated or will initiate corrective action for all of the recommendations.

** See glossary at end of report for definition.*

STATE OF MICHIGAN
OFFICE OF THE AUDITOR GENERAL
201 N. WASHINGTON SQUARE
LANSING, MICHIGAN 48913
(517) 334-8050
FAX (517) 334-8079

THOMAS H. MCTAVISH, C.P.A.
AUDITOR GENERAL

July 24, 2002

Mr. Barton W. LaBelle, Chairperson
State Transportation Commission
and
Mr. Gregory J. Rosine, Director
Michigan Department of Transportation
Transportation Building
Lansing, Michigan

Dear Mr. LaBelle and Mr. Rosine:

This is our report on the performance audit of the Design Division, Bureau of Highway Technical Services, Michigan Department of Transportation.

This report contains our executive digest; description of agency; audit objectives, scope, and methodology and agency responses; comments, findings, recommendations, and agency preliminary responses; and a glossary of acronyms and terms.

Our comments, findings, and recommendations are organized by audit objective. The agency preliminary responses were taken from the agency's responses subsequent to our audit fieldwork. The *Michigan Compiled Laws* and administrative procedures require that the audited agency develop a formal response within 60 days after release of the audit report.

We appreciate the courtesy and cooperation extended to us during this audit.

Sincerely,

Thomas H. McTavish, C.P.A.
Auditor General

This page left intentionally blank.

TABLE OF CONTENTS

DESIGN DIVISION
BUREAU OF HIGHWAY TECHNICAL SERVICES
MICHIGAN DEPARTMENT OF TRANSPORTATION

INTRODUCTION

COMMENTS, FINDINGS, RECOMMENDATIONS,
AND AGENCY PRELIMINARY RESPONSES

GLOSSARY

Description of Agency

The Michigan Department of Transportation (MDOT) was organized under Sections 16.450 - 16.458 of the *Michigan Compiled Laws* (Executive Organization Act of 1965). MDOT was established to provide the people of Michigan with a safe, efficient, and environmentally sound total transportation system in the most cost-effective manner.

The Design Division is 1 of 5 divisions within the Bureau of Highway Technical Services that provides construction plans and design services to MDOT staff in Lansing and at the 7 regional offices and 26 transportation service centers. The Division's mission is to:

> Provide and support the development of quality transportation project documents and services that meet the Department's strategic goals and exceed customer expectations for delivery of contracts on time and within budget.

The Division is organized into two units (Administrative Support and Local Agency Programs) and three sections (Design Operations - Road Section, Design Operations - Structures Section, and Design Services Section).

Administrative Support provides office management functions and liaison services with MDOT for the Division. Local Agency Programs administers the federal and State aid programs for local agencies.

The Design Operations - Road Section and the Design Operations - Structures Section are responsible for preparing preliminary and final design plans for construction or reconstruction of State trunkline roads and bridges; distributing design work loads among Lansing design, region design, and design projects awarded to design consultants; and coordinating region design squads in the preparation of preliminary and final plans for State trunkline roads and bridges.

The Design Services Section is responsible for coordinating and implementing automated engineering systems and standards for the Division, coordinating value engineering studies, and the review and approval of subdivision plats impacting State trunklines.

The Division's funding is provided from vehicle gasoline, weight, and value taxes plus sales taxes on vehicles, parts, and accessories. This funding is distributed to transportation programs in accordance with Sections 247.651 - 247.674 of the *Michigan Compiled Laws* (Act 51, P.A. 1951). Funding is also provided by the U.S. Department of Transportation from federal fuel and excise taxes on certain commodities.

Division expenditures, including design consultant contracts, were approximately $68.1 million for the fiscal year ended September 30, 2001. The Division had 280 full-time equated employees as of September 30, 2001.

Audit Objectives, Scope, and Methodology and Agency Responses

Audit Objectives

Our performance audit of the Design Division, Bureau of Highway Technical Services, Michigan Department of Transportation (MDOT), had the following objectives:

1. To assess the effectiveness of MDOT's life cycle cost analysis program.

2. To assess the effectiveness of the Division's quality assurance program.

3. To evaluate MDOT management's use of its program/project management system (P/PMS) for scheduling and managing design resources.

Audit Scope

Our audit scope was to examine the program and other records of the Design Division. Our audit was conducted in accordance with *Government Auditing Standards* issued by the Comptroller General of the United States and, accordingly, included such tests of the records and such other auditing procedures as we considered necessary in the circumstances.

Audit Methodology

Our audit procedures, conducted from February through June 2001, included examination of the Division's records and activities primarily for the period October 1, 1998 through June 30, 2001. Our audit methodology included conducting a preliminary survey of the Division to develop an understanding of its responsibilities and the methods that it used to monitor the accomplishment of these responsibilities. We reviewed prior audit reports and working papers of audits conducted by MDOT's Office of Commission Audits. We obtained Division design manuals for use as reference materials during our audit.

We reviewed the Division's procedures for preparing, reviewing, and submitting project design plans for bid lettings. This included the procedures for managing project designs prepared by private firms.

We received listings of construction projects that the Division released for bid lettings during our audit period. From those listings, we performed various tests to determine compliance with Division procedures.

We reviewed the Division's policies and procedures for maintaining and using its P/PMS. We obtained reports from P/PMS and performed various analytical tests.

Agency Responses

Our audit report contains 3 findings and 4 corresponding recommendations. The agency preliminary responses indicated that MDOT concurs with all 4 recommendations. In addition, MDOT informed us that it has initiated or will initiate corrective action for all of the recommendations.

The agency preliminary response that follows each recommendation in our report was taken from the agency's written comments and oral discussion subsequent to our audit fieldwork. Section 18.1462 of the *Michigan Compiled Laws* and Department of Management and Budget Administrative Guide procedure 1280.02 require MDOT to develop a formal response to our audit findings and recommendations within 60 days after release of the audit report.

COMMENTS, FINDINGS, RECOMMENDATIONS, AND AGENCY PRELIMINARY RESPONSES

The Michigan Department of Transportation (MDOT) annually submits over 400 State road and bridge construction project plans for bid letting. These design plans are prepared using both MDOT Design Division staff and consultant design firms. The Design Division is responsible for ensuring that the plans for these projects are prepared in accordance with MDOT and Federal Highway Administration design standards and specifications.

Our audit also includes the review of the life cycle cost analysis (LCCA) program. Responsibility for the program was transferred to the Construction and Technology Division from the Design Division during our audit period.

MDOT'S LIFE CYCLE COST ANALYSIS PROGRAM

COMMENT

Background: Act 79, P.A. 1997, required that MDOT develop and implement an LCCA program for all road construction projects that are expected to have a paving cost that exceeds $1 million. The purpose of this program was to require MDOT to design and award paving projects utilizing material having the lowest lifetime cost, which would include initial construction costs and subsequent maintenance costs for the design life of the roadway. MDOT, in conjunction with representatives of the concrete and asphalt industries, developed an analysis process that compares the cost of alternative construction materials and methods. This process is used to arrive at a conclusion as to which materials and methods will provide the lowest total construction and maintenance cost over the life of a highway. MDOT applies this process to projects for which it expects the paving cost, not the total project cost, to be greater than $1 million.

Audit Objective: To assess the effectiveness of MDOT's LCCA program.

Conclusion: We concluded that MDOT's LCCA program was effective in ensuring that the lowest life cycle construction cost alternative was selected for construction projects with paving costs greater than $1 million.

We reviewed the controls MDOT had in place to ensure that all applicable construction projects were subjected to an LCCA. We selected projects that went to bid during the 18-month period ended March 31, 2001 to determine if MDOT had conducted LCCA reviews as required. We also reviewed LCCA determinations to verify that the lowest cost alternative was selected for each project.

DESIGN DIVISION'S QUALITY ASSURANCE (QA) PROGRAM

Audit Objective: To assess the effectiveness of the Division's QA program.

Conclusion: We concluded that the Division's QA program was generally effective in helping to ensure that all road and structure plans were free of errors and omissions. However, we noted reportable conditions regarding QA reviews and design error notification.

FINDING

1. QA Reviews

MDOT needs to evaluate the Division's QA review process and revise its procedures to ensure effective reviews.

MDOT policy requires that all design plans go through the Division's QA review process. The purpose of the QA review is to ensure that plans and specifications of construction projects comply with MDOT and Federal Highway Administration standards and specifications. Division procedures provide that all plans are subjected to a minimum of two QA reviews. The first review is to be performed during the preliminary design process and the second is conducted near the end of the design process when the plans are reviewed for errors, omissions, and corrections.

During 1998, the State launched an initiative to rebuild many of the State roads and bridges, which increased the number of projects needing design plans. In addition, MDOT accelerated its bid-letting schedule so that the majority of its projects were let during the first six months of the fiscal year for each fiscal year from 1997-98 on. This action, along with the increase in the number of projects needing design plans, reduced the amount of time that the Division had available for performing its QA review process. In order to maximize its QA resources, the Division informally

prioritized the projects reviewed, placing high review priority on projects with estimated costs over $5 million. Projects estimated to cost less than $5 million but over $1 million were given medium review priority and projects under $1 million were given low review priority.

We reviewed the records of projects that went to bid lettings during fiscal year 1999-2000 and determined:

a. Of 32 projects that were estimated to cost over $5 million, 1 (3%) did not go through either QA review process and 8 (25%) projects did not go through one of the two QA review processes.

b. Of 96 projects that were estimated to cost less than $5 million but more than $1 million, 19 (20%) did not go through either QA review process and 37 (39%) projects did not go through one of the two QA review processes.

c. Of 69 projects that were estimated to cost less than $1 million, 29 (42%) did not go through either QA review process and 19 (28%) projects did not go through one of the two QA review processes.

We also reviewed the records of 7 projects that were involved in MDOT's alternative dispute resolution process. This process is used to resolve the financial responsibility of added construction costs on projects caused by design errors and omissions and other cost-related design consultant contract issues. We determined that 2 of the projects had not gone through either QA review process and 2 others had gone through only one of the two QA review processes. In addition, although the remaining 3 projects had gone through both QA review processes, the design errors were not identified.

Based on the results of our review, it appears that the Division needs to evaluate the effectiveness of its QA review process. Errors and omissions in design plans can cause costly overruns of construction costs to projects. By evaluating the effect of its QA review process, the Division could determine the need to modify its QA review process to minimize the number of errors and omissions.

RECOMMENDATION

We recommend that MDOT evaluate the Division's QA review process and revise its procedures to ensure effective reviews.

AGENCY PRELIMINARY RESPONSE

MDOT concurs with the recommendation. MDOT informed us that it recently has been prioritizing the QA review, based on risk and considering available resources. However, MDOT will evaluate the Division's QA review process to ensure effective reviews and to minimize the number of errors and omissions in design plans. Revised procedures will be issued and implemented by January 1, 2003. These new procedures will take into consideration the available staff resources, project size and complexity, and potential risks involved. Subsequent to implementation, the QA process will be monitored to evaluate its effectiveness.

FINDING

2. Design Error Notification

MDOT needs to develop procedures to ensure that the Division is notified of design errors noted during project construction.

MDOT uses an administrative review process for authorizing cost overruns and extra costs on construction projects. According to MDOT management, this process is also used to identify projects with potential design errors. During our audit, we determined that this method of identifying projects with potential design errors did not ensure that project design errors noted during construction were brought to the Division's attention for possible recovery of added construction costs or improvement in its own design work effort. Our review of 21 construction project files disclosed that 4 consultant-designed projects had some type of design error or omission that resulted in added construction costs. We did not find any documentation that the Division was notified of these errors or omissions. We could not identify the specific added costs attributed to these design errors; however, we did determine that the final project cost exceeded the original bid price for these 4 projects by a total of $3.6 million, ranging from $14,000 to $2.9 million per project. Although our review did not disclose any MDOT-designed projects with design errors or omissions, it is essential that field staff notify the Division of all projects with design errors or omissions to allow MDOT to take appropriate action.

Design errors and/or omissions can result in added costs to construction projects. MDOT requires all design consultants providing design services to provide $1 million of liability insurance in the event that the plans they develop contain errors or omissions. If these design errors or omissions result in added expense to MDOT, actions may be brought against the design consultant to recover the added costs from its liability insurance if the Division is made aware of the errors. Field staff notification of design errors noted during project construction may result in recovery of added costs caused by consultant design errors and/or omissions. In addition, notifying the Division of errors and/or omissions of in-house designed projects would allow it to take appropriate action to improve its own work.

RECOMMENDATION

We recommend that MDOT develop procedures to ensure that the Division is notified of design errors noted during project construction.

AGENCY PRELIMINARY RESPONSE

MDOT concurs with the recommendation. However, with regard to the finding that 4 projects had some type of design error or omission, MDOT informed us that it is reviewing the work authorizations to determine whether the cost increases were attributable to design errors and, if so, what action has been or will be taken by MDOT. MDOT's preliminary finding is that one project had the majority of the cost increases. This project was a design-build project that did not go through the normal plan development process because the contractor/consultant team was responsible for the full plan development. MDOT informed us that two of the major cost increases on this project appear to be the result of a change in site condition and project scope changes rather than design errors. MDOT informed us that further review of this and the other projects will be conducted. By January 1, 2003, MDOT will develop and implement procedures to ensure that the Division is notified of design errors and omissions noted during project construction.

PROGRAM/PROJECT MANAGEMENT SYSTEM (P/PMS)

Audit Objective: To evaluate MDOT management's use of its P/PMS for scheduling and managing design resources.

Conclusion: We concluded that MDOT management generally made effective use of its P/PMS for scheduling and managing design resources. However, we noted a reportable condition regarding P/PMS data accuracy.

FINDING

3. P/PMS Data Accuracy

MDOT needs to require design staff to accurately report time worked on design projects. In addition, MDOT needs to continue to improve the accuracy of the time estimates and standards used in P/PMS.

During 1993, MDOT hired a company to develop and implement a P/PMS to enhance MDOT's ability to schedule and monitor resource usage of its design work effort. P/PMS breaks down design work efforts into work tasks, which are assigned specific amounts of time needed to accomplish them. When a design project is assigned, managers identify the work tasks that will be needed to complete the project. Using P/PMS, managers can determine the amount of time needed to complete the project and monitor the progress of the project as it progresses. P/PMS was implemented in 1996 at a cost of $2.3 million.

During our audit fieldwork, Division management stated that manual records were still used to establish project timetables because the times assigned to work tasks in P/PMS were generally greater than the actual time required to accomplish the tasks. During 1998 and 1999, MDOT's Office of Quality and Reengineering and an outside firm, respectively, conducted reviews of P/PMS. These reviews concluded that MDOT needed to adjust the times associated with P/PMS tasks to adequately reflect the complexity of the work involved with project tasks, along with other improvements, to make P/PMS useful to management. During early 2001, the Division issued revised time standards for some P/PMS work tasks. We compared P/PMS information, management's estimated times, and payroll records for fiscal

year 1999-2000 and fiscal year 2000-01 to determine what effect the revised time standards had on P/PMS information. Following are the results of our comparison:

Fiscal Year 1999-2000

Location	Hours Staff Charged to Design Activities According to Payroll Records	Staff Time Available for Design Activities According to Management's Estimates	Staff Time Needed for Design Activities According to P/PMS
Superior Region	5,462	26,375	51,657
North Region	6,892	27,636	84,777
Grand Region	3,610	14,408	15,212
Bay Region	4,044	18,160	60,541
Southwest Region	3,386	14,480	122,985
University Region	2,623	14,936	9,811
Metro Region	4,335	10,626	15,689
Lansing Design Unit	55,139	168,291	241,595

Fiscal Year 2000-01

Location	Hours Staff Charged to Design Activities According to Payroll Records	Staff Time Available for Design Activities According to Management's Estimates	Staff Time Needed for Design Activities According to P/PMS
Superior Region	37,806	46,891	76,454
North Region	34,272	52,103	68,195
Grand Region	27,149	30,354	48,038
Bay Region	36,236	45,358	44,777
Southwest Region	31,943	26,346	38,680
University Region	17,960	33,986	25,784
Metro Region	38,484	197,374	53,592
Lansing Design Unit	305,623	323,938	349,230

Based on our comparisons, we concluded that improved time reporting, estimation, and standards have enhanced the usefulness of P/PMS. However, because of the variances that still exist between hours charged to design projects, estimated time

available for design activities, and P/PMS standards, we conclude that continued improvement is needed.

Accurate time reporting of design activities and realistic time standards are necessary for P/PMS to provide management with useful information for budgeting and managing staff resources.

RECOMMENDATIONS

We recommend that MDOT require design staff to accurately report time worked on design projects.

We also recommend that MDOT continue to improve the accuracy of the time estimates and standards used in P/PMS.

AGENCY PRELIMINARY RESPONSE

MDOT concurs with the underlying intent of the first recommendation. MDOT informed us that significant improvement in the accuracy of MDOT's design staff time reporting process has occurred and is evident from the audit findings. The Division has improved its accuracy, as its hours charged to the hours available ratio increased from 32.7% to 94.3% from fiscal year 1999-2000 to fiscal year 2000-01, respectively. MDOT will reissue instructions to staff involved in trunkline design plan preparation reminding them to comply with P/PMS time reporting requirements by January 1, 2003. Given the total hours that MDOT is accounting for, the nature of its work, and its attainment of the 94.3% accuracy, MDOT will now consider the cost effectiveness of any additional changes it initiates in this regard.

MDOT concurs with the second recommendation. MDOT informed us that, as discussed in its response to the first recommendation related to Finding 3, MDOT has made significant improvements in the accuracy of time reporting and in its development of time estimates and standards used in P/PMS during and subsequent to the audit period. MDOT noted that staff time available for design activities is an estimate based on available hours to dedicate to project design. The availability of staff changes because of other priorities and as staff vacancies occur within the year. The staff time available, in reality, will never match the charges to projects; however, it should be within a reasonable limit of the hours charged. Also, staff time needed for design activities is an estimate based on

average times from previous projects of a similar nature. MDOT informed us that, likewise, staff time needed, in reality, will never match the hours charged to projects; however, it should be within a reasonable limit of the hours charged. The hours needed are reviewed periodically to determine if current history of effort matches the standards. The review may result in standard changes; however, the changes will be reflected for future years' projects. A differential in the hours charged and the hours needed will exist, as it is inherent in the process of revising the standards. MDOT will continue to refine basic information and monitor future years' data to improve P/PMS, as it relates to the accuracy of time estimates and standards used.

Glossary of Acronyms and Terms

bid letting	The process of awarding a contract to a contractor based on the amount of a bid.
design consultant	A private firm hired to perform design services to supplement MDOT's design staff.
effectiveness	Program success in achieving mission and goals.
efficiency	Achieving the most outputs and outcomes practical with the minimum amount of resources.
LCCA	life cycle cost analysis.
MDOT	Michigan Department of Transportation.
P/PMS	program/project management system.
performance audit	An economy and efficiency audit or a program audit that is designed to provide an independent assessment of the performance of a governmental entity, program, activity, or function to improve public accountability and to facilitate decision making by parties responsible for overseeing or initiating corrective action.
QA	quality assurance.
reportable condition	A matter that, in the auditor's judgment, represents either an opportunity for improvement or a significant deficiency in management's ability to operate a program in an effective and efficient manner.